the ability of *Azotobacter* to grow in the presence of ether consisted in placing cylinders of potato in test tubes having plugs of absorbent cotton in the bottom saturated with pure ether. The slant of the potato was inoculated with the organism and incubated at room temperature. These cultures almost invariably had a growth at the end of from eight to ten days. The growth on potato had a decided stringiness. Stains from such a mass revealed a dense zooglea.

In the case of the cultures in liquid ether the only apparent source of carbon is the ether itself, and the bacteria are therefore under the necessity of using this in their metabolic processes. When the flasks containing old cultures were examined from day to day it was possible to detect what appeared to be the odor of alcohol and ether alternately. The successive hydration of ether and dehydration of alcohol would account for this phenomenon, but the probability of bacteria being able to induce these changes is certainly extremely remote. The oxidation of ether has recently been shown to result in the formation of aldehyde and acetic acid. Any attempt, however, to explain the nature of the process taking place in the flasks would be mere speculation, since the matter has not been experimentally investigated.

MAURICE MULVANIA

KNOXVILLE, TENN.

THE ROYAL SOCIETY OF CANADA

THE thirty-fourth annual meeting of the Royal Society of Canada was held in Ottawa, May 24 to May 27, inclusive, under the presidency of Sir Adolphe B. Routhier. The attendance was one of the largest in the history of the society, founded in 1882 by the Marquis of Lorne, at the time governor general of Canada. The four sections into which this national society is divided met under their respective presidents: Section I., French literature, history, archeology, etc. (in French); Section II., English literature, history, archeology, etc. In this section the following papers are of scientific value: "Some Notes upon the Discovery of a Prehistoric Human Skeleton in British Columbia," by Charles Hill-Tout. This skeleton came "from Undisturbed Strata in the white silts of the Interior Plateau" of that province, near Kamloops, and places the prehistoric history of man in western Canada back to the glacial period. "Social Organization of the West Coast Tribes," by Professor Adam Shortt, C.M.G., also forms an interesting study.

Section III., dealing with the mathematical, physical and chemical sciences, comprises numerous papers of special interest and value.

Professor R. F. Ruttan (McGill University), discussed "The Chemistry of Adipocere."

This paper deals with the changes in animal fats, as the result of prolonged action of moisture with the exclusion of air. The adipocere studied was found in a recent Post-Tertiary deposit of wet soil near Ormstown, Quebec. The material had the general character and appearance of soft chalk to the touch.

Another paper by Dr. Ruttan was entitled "Glycol Esters of the Fat Acids," pointing out a new series of fats formed by the replacement of ethylene glycol for the glycerol of ordinary fats.

Dr. Harding presented the result of investigations by him and Messrs. A. R. Maclean and F. H. S. Warneford, on "The Ninhydrin Reaction," being a critical study of this reaction for alpha amine acids, its quantitative relations and the chemistry of the color produced.

Then followed numerous contributions in the physical and mathematical sciences, and in astronomy, spectroscopy, electricity, metallurgy, meteorology, etc. These include:

A Comparison of Radium Standard Solutions: J. MORRAN. Presented by PROFESSOR A. S. EVE, F.R.S.C.

Notes on the Penetrating Radiation from the Earth: PROFESSOR A. S. EVE, F.R.S.C.

Some Experiments on the Thermionic Current: PROFESSOR A. S. EVE, F.R.S.C.

The Solar Rotation: DR. J. S. PLASKETT, F.R.S.C.

This paper gives the values of the spectroscopic determination of the Solar Rotation from plates made at Ottawa in the years 1911, 1912, 1913. A summary of the rotation values at different latitudes, the formula connecting the variation of velocity with latitude and discussions of other important aspects of the question was given.

The Determination of the Distance of the Nearer Stars from their Proper Motions and Radial Velocities: REYNOLD K. YOUNG, Ph.D. Presented by DR. J. S. PLASKETT, F.R.S.C.

From 167 stars whose parallax, radial velocity and proper motion are known, the direction and magnitude of the solar motion was found. The mean distance of the stars was evaluated by a comparison of the mean radial velocity and mean

proper motion at right angles to the direction of the sun's way, also by a comparison of the parallactic motion with the solar velocity. While the results of these two methods differ considerably their mean agrees with the observed parallax.

On the Electrical Conductivity of Air Confined in an Ice Vessel: Professor J. C. McLennan, F.R.S.C., and Mr. Harold G. Murray.

On the Residual Ionization in Gases over the Sea and on the Surface of Lake Ontario: Professor J. C. McLennan, F.R.S.C., and Mr. C. L. Treleaven, B.A.

On the Absorption Spectra of Zinc and other Metallic Vapors: Professor J. C. McLennan, F.R.S.C., and Mr. Evan Edwards, B.Sc.

Note on the Ultra-Violet Spark Spectrum of Silicon: Professor J. C. McLennan, F.R.S.C., and Mr. Evan Edwards, B.Sc.

On the Ionization Potentials of Mercury Zinc and Cadmium Vapors and their Single Line Spectra: Professor J. C. McLennan, F.R.S.C., and Mr. J. P. Henderson, B.A.

Application of Wilson's Method to a Study of the Ionization Paths of Alpha Rays in Hydrogen: Professor J. C. McLennan, F.R.S.C., and Mr. H. N. Mercer, B.Sc.

On the Delta Radiation from Zinc freed from Gases under Bombardment by Alpha Rays: Professor J. C. McLennan, F.R.S.C., and Mr. C. G. Found, B.A.

On the Infra-red Spectrum of the Mercury Arc: Professor J. C. McLennan, F.R.S.C., and Mr. R. C. Dearle, B.A.

On the Resolution of Spectral Lines by an Electric Field: Professor J. C. McLennan, F.R.S.C., and Mr. K. H. Kingdon, B.A.

On the Study of Röntgen Ray Spectra: Professor J. C. McLennan, F.R.S.C., and Mr. A. R. McLeod, M.A., and Mr. R. L. Lewis, B.Sc.

The Crushing Strength of Ice: Professor H. T. Barnes, F.R.S.C., and Mr. H. M. Mackay.

Experiments on large blocks of ice were made on the Emery testing machine. The results agree with those presented last year.

The Effect of Strain on the Thermal Expansion of Quartz: Professor H. T. Barnes, F.R.S.C.

Quartz rods were put under tension up to their breaking point and the coefficient of expansion measured between 0° and 100° C. No effect was observed.

Secondary Cathode Rays from Gases: A. Norman Shaw, D.Sc. Presented by Professor H. T. Barnes, F.R.S.C.

On Osmosis in Soils: C. J. Lynde, and V. V. Dupré. Presented by Professor H. T. Barnes, F.R.S.C.

This paper gives the results of experiments made to determine whether or not the pressures observed are due to osmosis.

On the Flow of Air in Two-dimensional Channels with Special Reference to the Stability of Stream Line Motion: Louis Vessot King, M.A. (Cantab.).

An account is given of experiments carried out with the author's hot-wire anemometer on the distribution of velocity in the flow of air between parallel planes. The observations were taken with a view of obtaining some light on the conditions which determine the breakdown of stream-line motion into turbulent flow.

On the Distribution of Air Velocity in the Neighborhood of a Rotating Cylinder: A. Gray, B.Sc., and Louis Vessot King, M.A. (Cantab.).

On the Calculation of the Self and Mutual Induction of Coaxial Cylindrical Coils: Louis Vessot King, M.A. (Cantab.).

I. A new method of deriving the formulæ for the self and mutual induction of coaxial cylindrical coils is obtained by reducing the problem to one of calculating a simple case of gravitational attraction.

II. By the application of Gauss's theorem of the Arithmetico-Geometrical mean, the calculation of the elliptic integrals which occur in the formulæ for self and mutual induction of coaxial single layer coils is made possible to a high degree of accuracy with comparatively little labor of computation and without the use of Legendre's tables.

III. Simple quadrature and graphical methods for the approximate calculation of the constants are also described.

Geometrical Configurations that lead to the Solution of a System of Partial Differential Equations of the Second Order: Chas. T. Sullivan. Presented by Dr. J. Harkness, F.R.S.C.

Progress on the 72-inch Reflecting Telescope: Dr. J. S. Plaskett, F.R.S.C.

The present condition of the grinding and polishing of the mirror and of the construction of the mounting will be described and illustrated by lantern slides.

Liquid Chlorine as a Solvent: Cryoscopic Measurements at Low Temperatures: P. Waentig and D. McIntosh, F.R.S.C.

Determinations of the lowering of the freezing point of chlorine by various solutes were made. Toluol, chloroform and various substances forming oxonium compounds such as ether, gave normal results; bodies containing the hydroxyl group were polymerized.

The Preparation of Metallic Vanadium: R. EDSON and D. MCINTOSH, F.R.S.C.

Vanadium was deposited on a heated wire from an atmosphere of a volatile vanadium compound and hydrogen.

Bromocamphor Sulphonic Acid and Oxonium Compounds: D. MCINTOSH, F.R.S.C.

An account of an unsuccessful attempt to prepare oxonium compounds.

The Viscosity of Ethyl Ether in the Neighborhood of the Critical Point: A. L. CLARK, B.Sc., Ph.D.

A Self-recording Instrument for Measuring Earth Temperatures: JOHN PATTERSON, M.A. (Cantab). Presented by R. F. STUPART, F.R.S.C.

The instrument consists of a Thread Recorder Galvanometer and a set of thermo couples connected through a special commutator to the galvanometer. A record is obtained of the temperature at the surface and at a depth of six inches twice every hour; below six inches the record is obtained once every hour at each depth.

On the Diurnal Changes in Magnetic Horizontal Force at Agincourt, 1902–1912: W. E. W. JACKSON, M.A. Presented by R. F. STUPART, F.R.S.C.

The mean diurnal inequality for each month of the year is treated by harmonic analysis and the seasonal variations brought out, and a comparison made with seasonal variations at Kew. Finally the abnormalities in the monthly diurnal ranges during years of maximum and minimum sun spots is shown, and also the variations in the seasonal values of the Fourier coefficient with the sun spots.

Comparison of the Callendar Sunshine Receiver and the Angstrom Pyrheliometer: JOHN PATTERSON, M.A. (Cantab). Presented by R. F. STUPART, F.R.S.C.

The comparison made by the author in 1912 showed that there was a very large difference between the two instruments, and the comparison has been continued in order to find out the cause of the difference.

The Diffusion of Oxygen Through Silver: F. M. G. JOHNSON, Ph.D., F.R.S.C.

Waves in a Jet of Water: MR. OTTO MAAS. Presented by D. MCINTOSH, Ph.D., F.R.S.C.

In Section IV. (Geological and Biological Sciences), Dr. Buller, of the University of Manitoba, Winnipeg, delivered the presidential address and discussed "Micheli and the Discovery of Reproduction in Fungi." The other papers included:

A Contribution to a Knowledge of Canadian Ticks: DR. C. GORDON HEWITT, F.R.S.C.

The economic importance of many of the native species of ticks in North America as responsible agents in causing certain known and obscure diseases or pathological conditions in man and domestic animals renders a knowledge of the occurrence and distribution of the species occurring in Canada very desirable. The present paper brings together in an accessible form information collected by the author and others.

I. *A Comparison of Spore-discharge in the Uredineæ and the Hymenomycetes:* A. H. REGINALD BULLER, D.Sc., F.R.S.C.

A minute study of the discharge of sporidia from the promycelium of a rust fungus and from the basidiospores of Agarics has provided evidence that the processes of discharge in the Uredineæ and Hymenomycetes are identical in nature. (Lantern slides.)

II. *The Movements of Spirogyra:* A. H. REGINALD BULLER, D.Sc., F.R.S.C.

The free ends of *Spirogyra* filaments execute fairly rapid bending movements, the result of which is that the filaments become twined around one another so as to form wisps. The filaments in each wisp lie more or less parallel to one another. The parallel situation of the filaments in any wisp eventually facilitates scalariform conjugation. The movements therefore have a biological significance. (Lantern slides.)

On the Taxonomic Value of the Placenta: DR. ARTHUR WILLEY, F.R.S.C.

The paper discusses the relations of the various forms of placenta in the light of recent advances in mammalian embryology, with special reference to the gestation of the Canadian beaver.

Comorocystitis punctatus Billings: SIR JAMES GRANT, K.C.M.G., F.R.S.C.

A Cystidian from Ottawa.

The Cretaceous Sea in Alberta: D. B. DOWLING, F.R.S.C.

A fairly extended description of the formations underlying the plains is available in the several reports that have been made by various observers. The beds composing these formations have been examined in many localities and the animal re-

mains that have been found indicate the character of the medium of distribution. Some of the deposits suggest the presence for a time of a wide shallow muddy sea. Others are evidently near-shore deposits with remains of brackish-water or even fresh-water life. The final retreat of the sea from the central part of the continent is marked by a series of brackish-water deposits covered by material that has been distributed by fresh-water streams or in lakes.

In the western part of Alberta there are indications that the western margin of the marine invasion can be located and that there was at various periods a distinct narrowing of the sea so that land areas appeared which occupied portions of the present area of western Alberta. An attempt at defining the western margin of the Cretaceous sea at successive stages is made in the paper. This shows graphically in the retreat of the sea the inauguration of a period of unrest which later culminated in the elevation of this part far above the sea and finally in the formation of the Rocky Mountains.

Notes on some hitherto Unrecorded Occurrences in British Columbia, of Uncommon Minerals, Collected by the late W. J. Sutton, of Victoria: R. W. Brock, F.R.S.C.

The late W. J. Sutton, of Victoria, made an extensive private collection of rocks and minerals. In it are a number of specimens of minerals from British Columbia, whose occurrences have not as yet been brought to the attention of the scientific world. Mr. Sutton, no doubt, would have described these in detail; the writer can only mention such as he noticed, but places them before the society in order that they may be credited to this earnest and enthusiastic mineralogist and geologist.

A British Columbia Example of the Contact Metamorphism of a Granite Rock to a Garnet: R. W. Brock, F.R.S.C.

Contact metamorphism is a common phenomenon in British Columbia. Limestone, here as elsewhere, is the rock which most frequently shows pronounced effects of this process. In the Boundary Creek District, while this is also the case, other rocks have been affected in like manner, though the late S. F. Emmons and other authorities who visited the Boundary Creek District have expressed the opinion that such alteration was confined to the limestones. An unequivocable instance of the alteration of granodiorite occurs on Pass Creek, as mentioned by the writer in the Summary Report of the Geological Survey for 1902. Although other instances of somewhat similar occurrences are now generally recognized and accepted, this occurrence is deemed worthy of a more extended description than it received in the Summary Report above mentioned, as being one of the most definite and striking examples of such metamorphosis yet found.

The Upper Limit of Temperature Compatible with Life in the Frog: A. T. Cameron and T. I. Brownlee. Presented by Dr. Swale Vincent, F.R.S.C.

Frogs (*R. pipiens*) will endure an (internal) temperature of 28° C. for several hours. A temperature of 30° C. is fatal in six hours. Death is apparently produced through some coordinating mechanisms in the central nervous system, since the individual tissues (striped muscle, heart, peripheral nerve and brain and cord) survive, and are only killed by distinctly higher temperatures. The results are therefore in line with those found by the authors of the lower limit of temperature compatible with life.

On an Accumulation of Gas in the Tissues of the Frog as a Result of Prolonged Submersion in Water: A. T. Cameron and T. I. Brownlee. Presented by Dr. Swale Vincent, F.R.S.C.

Frogs (*R. pipiens*) submerged completely in running water, but free to move, survive, on the average seven days, though individuals may survive three weeks. About two days before death they commence to swell, and rapidly become so buoyant that they can not any longer dive. The cause of death appears to be connected with this distension, which is caused by gas, distributed throughout the body and all tissues. The gas is almost pure nitrogen, and may amount in volume to 15 c.c. or over.

On the Relative Importance to Life of the Cortex and the Medulla of the Adrenal Bodies: T. D. Wheeler and Swale Vincent, F.R.S.C.

As the result of a long series of experiments upon dogs, cats and rabbits, in which the medulla was removed as completely as possible (without inflicting more than an unavoidable damage to the cortex), it would appear that the cortex is the part which is essential to life, and that the chromaphil tissue constituting the medulla can be entirely removed without any serious results.

A Study of some Organisms which Produce Black Fields on Æsculin-bilesalt Media: F. C. Harrison, D.Sc., F.R.S.C.

In the summer of 1913 more than 4,000 Æsculin-bilesalt agar plates were made from samples of

milk obtained from more than a thousand different dealers or farmers in the province of Quebec.

Seven hundred colonies from these plates were selected for further study, and we found 11 organisms which developed black fields in less than 48 hours on æsculin-bilesalt media at blood heat, and which did not belong to the colon-aerogenes group. These organisms came from the vicinity of Huntingdon, Quebec, but could not be isolated from milk obtained from this district the following spring.

By keeping the æsculin-bilesalt agar plates at room temperature for at least five days, more exceptions appeared, seven of which were carefully studied.

The Harrison-Barlow Nitrocultures and their Commercial Application: F. C. HARRISON, D.Sc., F.R.S.C.

At the meeting of the Royal Society held in May, 1906, Harrison and Barlow read a paper on the "Nodule Organism of the Leguminosæ—Its Isolation, Cultivation, Identification and Commercial Application." Since that date large numbers of the so-called nitro-cultures prepared according to the directions given in the above mentioned paper were distributed to farmers in Canada and the United States. This paper gives a short account of the commercial application of these nitro-cultures between 1906 and 1914.

The Diatoms of the Coast of Vancouver Island, B. C.: DR. L. W. BAILEY, F.R.S.C., and DR. A. H. MACKAY, F.R.S.C.

So far as known to the writers of this paper no publications relating to the diatoms of the Pacific Coast of Canada have as yet been made. The establishment of one of the stations of the biological board of Canada at Nanaimo, B. C., having made it possible to obtain materials for the study of these organisms, some of the results of that study are here presented in preliminary form.

The total number of species so far identified is over 250, of which a list, with diagnostic measurements, is given. Of these several are believed to be new. The characteristics of the phytoplankton are distinctly indicated and comparisons are drawn between those of the Pacific and Atlantic coasts, as well as those of the North Sea and the Antarctic, to the latter of which the Vancouver collections bear interesting resemblances.

Metallogenetic Epochs in the Pre-Cambrian of Ontario: WILLET G. MILLER, F.R.S.C., and CYRIL W. KNIGHT.

During the vast period represented by the pre-Cambrian rocks of Ontario ore deposits were formed at various epochs. Knowledge of the pre-Cambrian gained during the last decade furnishes a means of correlating these ore deposits as regards their age and genetic relations.

Modes of Occurrence of some Gold-bearing Veins in the Pre-Cambrian Rocks of Canada: J. B. TYRRELL, F.R.S.C.

For nearly fifty years gold has been known to occur in mineral veins in the pre-Cambrian rocks of Central Canada. While the great majority of these occurrences have been too small or poor to allow of mining and milling at a profit, the rich and extensive gold-bearing veins found within the last few years in northern Ontario show that all the gold prospects in the country are not "Will-o-the-wisps" which exist only for the purpose of enticing eager and unwary investors to destruction.

In the present paper the author attempts to give a brief outline of the character of the mineral veins in the pre-Cambrian rocks of central and northern Canada in which gold has been found; the modes of occurrence of gold in these veins, and the character of the rocks which form their walls, or which are sufficiently near to suggest some genetic relationship between them.

A New Myxobacterium: J. H. FAULL, Ph.D., F.R.S.C.

The microorganisms of this form heap up, organizing a stalked, branched or unbranched, one to several-headed fruiting body. On the heads columnar or conical cysts develop, on the surfaces of which a membrane is secreted. From these cysts, the bacteria later migrate into the main body of the head, the husks of the cysts persisting as shrivelled and twisted curls. The species exhibits a remarkable variability in respect to the morphological features of its fruiting bodies. It stands out as one of the most highly specialized of the order to which it belongs.

Some Anatomical Features of Willow Galls and their Significance: A. COSENS, M.A., Ph.D., and T. SINCLAIR, M.A. Presented by J. H. FAULL, Ph.D., F.R.S.C.

A study of the anatomy of certain willow galls led to the discovery of a well-defined aeriferous tissue which is not present in the corresponding regions of normal plants. A search for this tissue in normal plants led to its discovery in primitive areas or "vestige-carriers." Various experiments were made with negative results, to see if this tissue could not be induced by changing the environment. The conclusions reached are: (1) that

this is a primitive tissue in the willows and not a modification of the normal tissues due to changed environment; (2) that the reinstatement, under stimulus of vestigial characteristics in a plant has an important bearing on the question of gall production, for the gall producer not only exercises directive control over the active characteristics of the protoplasm, but over dormant as well. Under these conditions, unexpected structures and unusual combinations may well be produced.

On a Pre-Cambrian Outlier in Central Manitoba: Professor R. C. Wallace. Presented by A. H. Reginald Buller, D.Sc., F.R.S.C.

The Swarming of Ondotosyllis: C. McLean Fraser, Ph.D. Presented by A. B. Macallum, Ph.D., F.R.S.C.

Bibliography of Canadian Botany for the Year 1914: Dr. A. H. MacKay, F.R.S.C.

Bibliography of Canadian Geology for 1914: Wyatt Malcolm. Presented by R. G. McConnell, B.A., F.R.S.C.

Bibliography of Canadian Entomology for the Year 1914: Rev. C. J. S. Bethune, D.C.L., F.R.S.C.

Bibliography of Canadian Zoology for the Year 1914 (Exclusive of Entomology): E. M. Walker, B.A., M.B.

Henri M. Ami

SOCIETIES AND ACADEMIES

THE AMERICAN MATHEMATICAL SOCIETY

The twenty-second summer meeting of the society was held at the University of California on Tuesday and at Stanford University on Wednesday, August 3–4, 1915, in connection with the Panama-Pacific International Exposition, thirty-four members being in attendance. Professor M. W. Haskell, chairman of the San Francisco section, presided on Tuesday afternoon, and Professor R. E. Allardice at that on Wednesday afternoon.

Tuesday morning was devoted to a joint session with the American Astronomical Society and Section A of the American Association for the Advancement of Science. Addresses were delivered by Professors C. J. Keyser on "The human significance of mathematics," and G. E. Hale on "The work of a modern observatory." The astronomers, mathematicians and physicists lunched at the Faculty Club as guests of Professors Leuschner, Haskell and E. P. Lewis.

The social program included a dinner with the American Astronomical Society at the Hotel Oakland on Wednesday evening, an excursion to the Lick Observatory on Friday, and a luncheon given by Mrs. Phoebe Hearst at the Hacienda del Pozo de Verona on Saturday.

The following papers were read at this meeting:

L. E. Dickson: "Invariantive classification of pairs of conics modulo 2."

C. J. de la Vallée Poussin: "Sur l'intégrale de Lebesgue."

A. R. Schweitzer: "On the solution of a class of functional equations."

Nathan Altshiller: "On the circles of Apollonius."

Dunham Jackson: "Proof of a theorem of Haskins."

W. W. Küstermann: "Fourier constants of functions of two variables."

B. A. Bernstein: "A set of four independent postulates for the logic of classes."

G. A. Miller: "Limits of the degree of transitivity of substitution groups."

R. D. Carmichael: "On the representation of numbers in the form $x^3 + y^3 + z^3 - 3xyz$."

H. S. White: "Seven points on a gauche cubic curve."

M. W. Haskell: "The del Pezzo quintic curve."

L. J. Richardson: "A phase of Roman mathematics."

C. A. Fischer: "Functions of surfaces with exceptional points or curves."

A. R. Williams: "On a birational transformation connected with a pencil of cubics."

F. N. Cole: "Note on the triad systems in 15 letters."

A. B. Coble: "The determination of the lines on a cubic surface."

H. S. Vandiver: "An aspect of the linear congruence, with applications to the theory of Fermat's quotient."

C. H. Forsyth: "An interpolation formula based upon central and multiple differences."

G. M. Green: "On isothermally conjugate nets of space curves."

L. P. Eisenhart: "Surfaces of rolling and transformations of Ribaucour."

A. R. Schweitzer: "Generalized quasi-transitive functional relations."

L. M. Hoskins: "'Quantity of matter' in dynamics."

A. A. Bennett: "The iteration of functions of one variable."

The next meeting of the society will be held in New York, on October 30.

F. N. Cole,
Secretary